Report 1-Part 3-Restaurant Automation

FOOD BYTE

Group no #1

Team Memebers:

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“All the members in our team contributed equally!”

Summary of changes:

The restaurant automation has always made the work easier for the employees and satisfactory for the customers. In our project we have included the data analytics which will be useful for the management to take wise decisions and improve the organization profitably. Our project aims at performing analysis using relevant data with the main purpose of improving the business of the restaurant by keeping the customers‟ interests at the focal point, increasing the revenue and reducing the waste generated. We have segregated the data to be analyzed into modules for a detailed computation. They include the analysis based on the customer density, item based revenue maximization, inventory management and trend based on geography analysis. The data set used in this project has been created by our team using the XAMPP server which has inbuilt functions to support PHP and My SQL. The data analytics is to be done in python. We have also changed and updated the logo.

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1. PROJECT DESCRIPTION

Using our restaurant automation application, restaurants can increase the efficiency of daily operations with a central system to track all aspects of restaurant management, individual customer transactions, observing profit, costs, revenue, analyzing and optimizing the menu based on collected data.

Lately, data analytics is being used in many fields to derive insight on how the business/organization is running as it enables them to look for meaningful patterns and correlations in their business. Companies benefit from this as they are entitled to make better decisions in the future by analyzing data from the past. Our system incorporates the concepts of data analytics in the restaurant business to enable features such as trend analysis based on geography of the restaurant, customer density analysis based on time of day, item-based revenue maximization and inventory management.

2. CUSTOMER STATEMENT OF REQUIREMENTS

For this project, the customer will be the restaurant management.

2.1. Inventory Management to Reduce Waste

2.1.1. Problem Diagnosis:

Managing a restaurant is a very difficult job. There are many variables surrounding all elements. Starting a restaurant is not an inexpensive idea. To keep the expense according to the budget, many factors are to be considered. One of the main problems that almost all restaurants face is to determine the amount of food to be bought in. This problem is steeper for newly commenced restaurants. If a good deal of food is bought, and the demand is less, the food may be wasted, and it may contaminate the newer products. On the other hand, if the stocked food is not enough i.e. if the demand is more, the restaurant may run out of food quickly. This may cause the restaurant to close before the allotted closing time and may leave some customers displeased. Each ingredient has a different usage rate, so the demand of each ingredient changes based on the usage. If the old ingredients are not disposed and the newer products are placed near the older products, this may result in the contamination of the newer ingredients.

2.1.2 Proposed Solution:

Having a detailed Inventory, helps us to determine the amount of food that we have and the amount of food that we need. It helps us avoid surplus as well as food shortages. Based on the data and the trend, we will try to predict the rate of use of certain ingredients and will generate the adequate quotation of the required ingredients before they replenish. This will be done by using Data Analytics, analyzing the trend of the consumption of each ingredient over time, and thus, notifying the pantry of the requirements well in advance.

The average waste rate for full-service eateries is 3.11% [1]. Hence, we will also focus on the First In First Out technique to ensure that no food waits for a long time on the shelf before usage. This will help the restaurant avoid wastage of food that has been sitting the shelf for a long time.

2.1.3. Plan of Work and Product Ownership:

Our inventory will consist of the following information:

1. Item Name
2. Unit of Measurement
3. Inventory Amount
4. Unit Price
5. Total Cost
6. Usage in Dishes

Prince and Sarthak will use the data along with: usage and quantity of each ingredient in a dish, the frequency of the number of tables that ordered for that dish and average consumption of the dish per week/month, that will help us to understand the rate of consumption of an ingredient.

We will also suggest changes in the menu, if an ingredient has been waiting on the shelf for a long time and needs to be used to avoid contamination.

Prince and Sarthak: Our plan over the next few weeks is to make and link Ingredient Lookup tables and Ingredient Availability tables to our Server side program. Once we do that, we plan to read that data and implement different Data Analytic techniques to infer conclusions and possible solutions.

We want to add the following functionalities:

- Ingredient Consumption: To understand the rate of usage of specific ingredients, maximize profitability, and reduce wastage.
- Suggest Changes to the Menu: To increase profitability by making dishes that will help replenish the least used ingredients and avoid wastage.

2.2 Trend Analysis Based on Geography

2.2.1. Problem diagnosis:

Loss occurring because of using same menu across different geographical locations

The location of a restaurant has a significant impact on the sales of food items. Restaurants normally tend to create a fixed menu irrespective of the choice of people living in that area. For example, people living in the west coast prefer fusion cooking in contrast to the people in east coast who prefer classics. In this case, a restaurant can incur a loss if it does not customize its menu according to the food preference of the people living in that area. In addition to this they do not generally discard items with no or fewer sales.

2.2.2. Proposed Solution:

To regulate the price of food items based on the sales at specific locations. The database will keep a track of the sales information and the server will have a popularity index. This data will be fetched by the data analytics module which will utilize an algorithm that will inform the server about a range of prices that can be changed for this product and a notification to the inventory to increase the stock.

Tracking of unsold items on the menu. If an item on the menu is not being sold as expected, we will either reduce its price, advertise with an offer or remove it from the menu. In this case we can use the same popularity index for regulation of the unpopular items.

2.2.3. Plan of Work:

Yashasvi and Akshay: Our plan to accomplish in the next few weeks will be to create sample data sets of different food items of a restaurant at different locations and to categorize them into different sub groups according to their sales and apply analytics to this data to increase the profits by customizing the menu. Following are the groups based on popularity index:

1) Favorite

2) Least sold

3) Can be improved

2.3. Analysis Based on Customer Density

2.3.1. Problem Diagnosis:

In the current day working scenario of restaurants, the management does not tend to concentrate more on the number of customers visiting their restaurants during different periods of the day. The hotel management always expect a big number on their customer scale. On the contrary, the number is not always uniform. Without analysis, the hotel tends to assign a lot of employees during the off-peak hours. Hence, the food prepared, and the human resource assigned during the minimal visit time zone gets wasted. Additional employees result in additional wage expenses to the management. The vice-versa of this situation is also possible. Number of waiters to attend to the customers during peak hours might be less. All these are the results of lack of analysis based on customer density.

2.3.2. Proposed Solution:

To overcome this inequality between customers and resources, we propose a detailed survey to determine the number of customers in the restaurant during different periods of the day, week, month and year. Based on this survey, the management can plan ahead on the number of

employees and their work shifts required during the day. This analysis helps the management in efficiently and economically allocating the resources on a day to day basis, and to also plan to meet future needs based on the trend observed.

2.3.3. Plan of work:

Anvitha and Priyanka will implement the following strategy -

- Collect data on the number of customers visiting the restaurants in a day (morning/afternoon/evening/night), a week, a month and a year.
- Analyze the types of customers visiting the restaurants; adults, children, vegetarians, non-vegetarians.
- Using the gathered information, data analytics is performed to calculate the average number of employees required during the different working hours of the day, and the approximate kind of food that must be prepared to satisfy the needs of the visiting customers. This helps the management reduce human resources as well as monetary resources.

The management can also use the results of the analysis to improve different aspects of their business. For instance, if the restaurant is not attracting as many customers as they would during a particular period, they may conduct a survey to determine why customers do not frequent the restaurant during those periods and find a solution to bridge the gap between the customers‟ needs and the restaurants‟ service. In this way, customer relations as well as the quality of service can be enhanced, thereby improving the business which leads to increased profits.

2.4. Item Based Revenue Maximization:

2.4.1. Problem Statement:

Currently, restaurant managers do not have statistics as to how the various items in their menu sells. It is assumed that every item on the menu will be ordered almost the same number of times, except for one or two „customer favorites‟. There is no store specific data to assess the items that are being sold and their exact volumes. Managers are not wary of the demands that may arise for a particular item in the near future, hence the quality of service will take a hit when such a situation arises where a certain item is in high demand but the kitchen is not equipped to supply the same. On the contrary, there are a few items on the menu that do not sell at all or sell very less. The restaurant ends up wasting a substantial amount of resources in trying to keep that item „ready to serve‟.

2.4.2. Proposed Solution:

We propose to aid the managers in determining trends in the way different items in the restaurant menu sell, so that they are prepared for situations like a sudden hike in demand for a particular item. This way they will not lose out on revenue that could have been generated if the kitchen could keep up with the demand. On hindsight, the restaurant can also avoid wasting resources by preparing items that are seldom sold.

2.4.3. Plan of Work:

Ashwin and Suraj will use the following approach:

- Talk to restaurant managers and enquire about the obstacles they currently encounter while preparing and selling various items in the menu.
- Collect data on the various items on the menu and the number of portions sold throughout the week.
- Determine the time of day(morning/noon/evening) during which each item is sold the most and least.
- In the coming weeks, use data analysis to determine trends and patterns in the way various items in the menu sell using the data from the restaurant‟s sales database.
- With this organized information, the future trends in restaurant sales can be determined beforehand which will be a great asset for restaurant operation.

3. GLOSSARY OF TERMS:

3.1. Technical Terms:

Database: The structured set of data collected and stored based on food items, inventory, customer profile specific to different locations.

Graphical user interface: The interface that allows the user to interact with the application through graphical icons and visual indicators.

Data Sets: Collection of data that corresponds to the contents of a single database table.

Data Analytics: The process of analyzing the collection of data to draw useful conclusions and make informed business decisions.

3.2. Non- Technical Terms:

Inventory: The list of food items and the ingredients used to prepare the food.

Geographical location: The state wise location of different branches of the same restaurant.

Popularity index: To indicate the frequency of food items ordered.

Customer Density: The number of customers visiting the restaurant during a interval of time.

Off peak hours: The period when the restaurant experiences a lower customer density.

Human resources: The number of workers employed.

Ready to serve: The prepared food that is available for immediate consumption by the customer.

4. SYSTEM REQUIREMENTS

Table 1

Requirements	Priority	Description
RQ 1	5	The system shall obtain data from the POS system throughout the day and store it in the database.
RQ 2	4	The system shall retrieve item wise sales data from the database to analyze the trend in sales of various items.
RQ3	3	The system will prioritize the items based on the frequency of sales throughout the day for the entire week.
RQ4	4	The system will predict and suggest the items which may be in high/low demand based on time of day
RQ5	4	The system will retrieve data on the number and type of customers visiting the restaurant during different period of the day, month, year.
RQ6	3	The system will analyze and determine the peak/off-peak working hours, demand on the type of food.
RQ7	4	The system will provide the minimum number of workers required during a shift, suggest new additions in menu, changes in ambience and introducing new offers.
RQ8	4	The system will retrieve the data based on location of the restaurant and its popularity index.
RQ9	3	The system will prioritize the food items based on its popularity at specific locations.
RQ10	4	The systems will recommend the changes in menu, price reductions and suggest special offers.
RQ11	4	The system shall use the inventory to suggest quantity of food to

		be added to the quotation for the month.
RQ12	3	The system shall keep track of the older products on the shelf and push them forward for usage before replacing with newer ones.
RQ13	4	The system shall consider the rate of usage for each ingredient before making a quotation.

5. DATA SETS

We will create a customized database based on the combination of the existing datasets of restaurants available online.

We will primarily have 2 datasets -

1) User Dataset – This set will have Food items, Price, Discount, Type of Customer (Based on Age), Location of the restaurant, Time of Order as the columns.
2) Inventory Dataset – This set will have details of individual raw materials, Quantity left, Total Quantity, Perishable items.

Part 1 – Creating the data sets

We will use XAMPP server which has support for both PHP and MySQL. We will create a portal in PHP from where users can select the food items. For each selection we will embed this choice with the location information, time of the day, Price, discount and it will be stored to the database as a single entry.

Part 2 – Accessing the datasets and analyzing information

We will use python for data analytics. We will access the database from the "sql-connector" package available in python.

6. USER STORIES: As a Restaurant Manager

Identifier	User Stories	Size
ST1	I can determine who has access to the point of sales system.	3
ST2	I can determine who has access to the trends obtained from restaurant data analytics.	3
ST3	I can modify the menu based on the current trends recorded.	6
ST4	I can modify the price of various items on the menu and work on restaurant offers.	6
ST5	I can decide the number of employees on duty for a particular time of the day and day of the week.	5
ST6	I have access to the sales, inventory and employee database of the restaurant for verification and validation.	4
ST7	I decide on the inventory to be ordered based on requirements from the kitchen.	5
ST8	I have access to the profit/loss statements of the restaurant.	5

Table 2

As a chef

Table 3

Identifier	User Stories	Size
ST1	I have access to the item inventory database.	3
ST2	I can request/approach the restaurant manager regarding changes in the menu items based on usage.	5
ST3	I can reason with the manager to make sure of the feasibility of a menu change decision.	4
ST4	I have access to the anticipated trends in item sales.	3
ST5	I can optimize inventory usage to minimize waste.	6

As a Waiter

Table 4

Identifier	User Stories	Size
ST1	I am responsible for entering the orders into the point of sales system	5
ST2	I am responsible for tallying the current order and the items served on the table	4

7. FUNCTIONAL REQUIREMENT SPECIFICATION:

7.1 Stakeholders:

Stakeholders are the people interested in the success of the organization. They are classified as primary and secondary stakeholders. In our case, the primary stakeholders are the managers, host and the other staffs working in the restaurant who will be directly utilizing the system. The Another set of stakeholders will be the customers who don‟t directly use the system by themselves, but their feedback and experience plays an important role in the improvement of the organization.

7.2. Actors and Goals:

Manager

Role: The person who manages the entire restaurant.

Goals: Manages inventory, payroll, employee scheduling.

Host

Role: The person who interacts with the customer and waiter.

Goals: Seats guests and assigns waiter to tables

Waiter

Role: The employee who interacts with and serve dine-in customers.

Goals: Takes customers‟ orders to the kitchen and delivers the prepared order to the customer

Cook

Role: The person who oversees the kitchen and preparing meals.

Goals: Reads the order details received from the supervisor, prepares the food, and informs the supervisor when it is ready

Busboy

Role: The person who is responsible for the cleanliness of the restaurant.

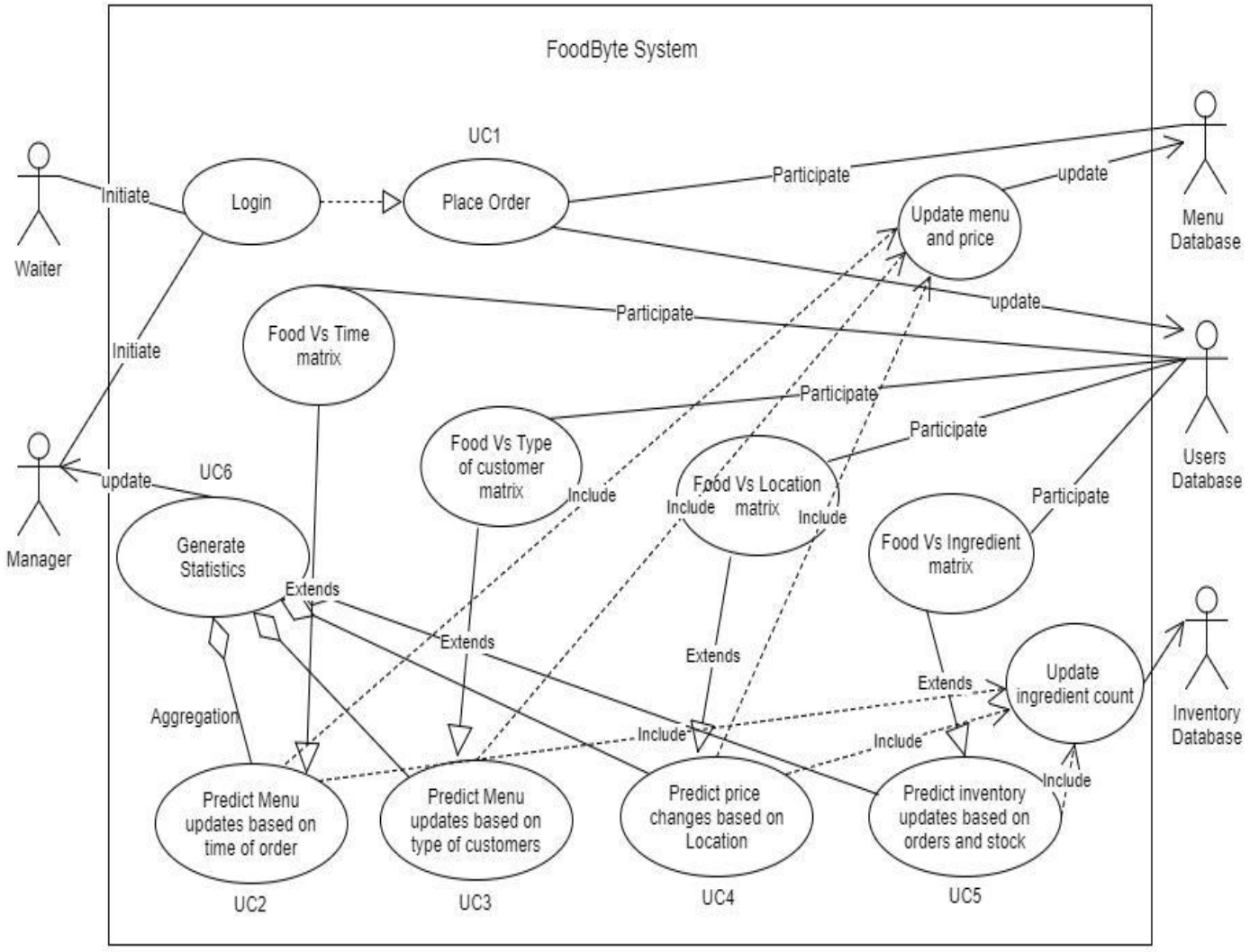
Goals: Keeps track of which tables are being used; cleans tables and updates their status as necessary

7.3. Use Cases

7.3.1 Casual Description

1) **UC1** – **To place the order**. This use case will involve displaying the menu portal using the menu table from the database. It will also detect the user selection food item and add a new entry into the Users database.
2) **UC2** – **Analyze trend in sales based on the time**. This will involve keeping a track of the frequency of sales at various times during the day and predict increase/decrease in demand at specific hours.
3) **UC3** – **Analysis based on Customer density**. This will involve keeping track of the type of customers based on age, interests and correlating it with the food items purchased. Finally, it will make a prediction about the type of food items preferred by specific type of customers and notify about menu updates required if any to the management.
4) **UC4** – **Trend analysis based on Geography**. This use case involves keeping a track of the popularity of food items across different locations of the restaurant. It will then make predictions about the change in menu, price modifications or offers based on the results of classification.
5) **UC5** – **Inventory management**. This will involve keeping a track of the raw materials in the inventory based on the customer selection of food items. It will then predict the required updates of raw materials in the inventory.
6) **UC6** – **Maintaining Statistics**. This involves combining the results of all the data analytics features and providing statistical reports about this data to the restaurant manager.

7.3.2 Use Case Diagram



7.3.3 Traceability Matrix

Table 5

	UC1	UC2	UC3	UC4	UC5	UC6
RQ1	**X**					
RQ2	**X**	**X**				
RQ3		**X**				
RQ4		**X**				**X**
RQ5	**X**	**X**	**X**			
RQ6		**X**	**X**			
RQ7			**X**			**X**
RQ8	**X**			**X**		
RQ9				**X**		
RQ10				**X**		**X**
RQ11	**X**				**X**	
RQ12					**X**	
RQ13					**X**	**X**

7.3.4. Fully Dressed Use Cases

Table 6

USE CASE UC1	**To Place an Order**
Related Requirements	RQ1, RQ2, RQ5, RQ8, RQ11 from Table1
Initiating Actor	Waiter
Actor's Goal	To take the order from the customer and select it in the FoodByte portal
Participating Actors	Menu Database, Users Database
Preconditions	- Menu Database should contain the updated values - The FoodByte portal should be synced with the Menu Database
Postconditions	The User Database should be updated with the Customer selection and notification to be sent to the Data analytics modules to start processing
Flow of Events for Main Success Scenario	→ 1. Waiter enters login information into the portal ← 2. System retrieves the Menu from the Menu Database and displays it on the portal → 3. Waiter enters the customer selection and an entry is made in the User Database ← 4. System signals the Data analytics module about the new entry.

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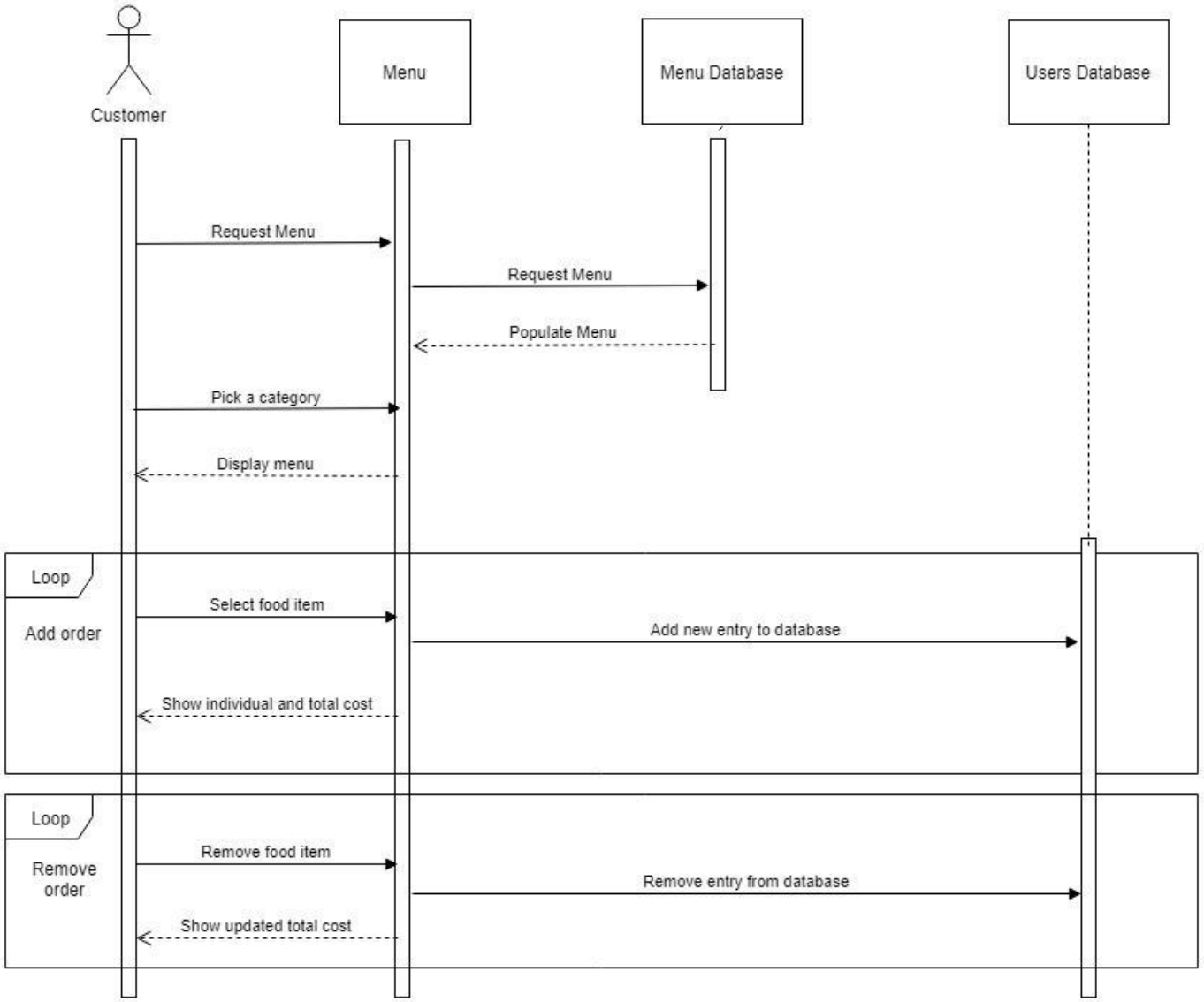

Customer
Menu
Menu Database
Users Database
Request Menu
Request Menu
Populate Menu
Pick a category
Display menu
Loop
Add order
Select food item
Add new entry to database
Show individual and total cost
Loop
Remove order
Remove food item
Remove entry from database
Show updated total cost

Table 7

USE CASE UC2	**Trend Analysis in sales based on time**
Related Requirements	RQ2, RQ3, RQ4, RQ5, RQ6 from Table1
Initiating Actor	FoodByte system
Actor's Goal	To retrieve entries from the Users Database and provide sales predictions at specific times
Participating Actors	Users Database, Inventory Database
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs time dataset in the required form
Postconditions	The system should use the Food item vs Time matrix from the dataset and provide predictions about the demand at specific times during the day
Flow of Events for Main Success Scenario	→ 1. The system receives notification about new entries from portal ← 2. System retrieves the required dataset from the Users database ← 3. System predicts changes in demand during the day, informs inventory and suggests menu updates based on these predictions. ← 4. System will consolidate these predictions to display statistical reports

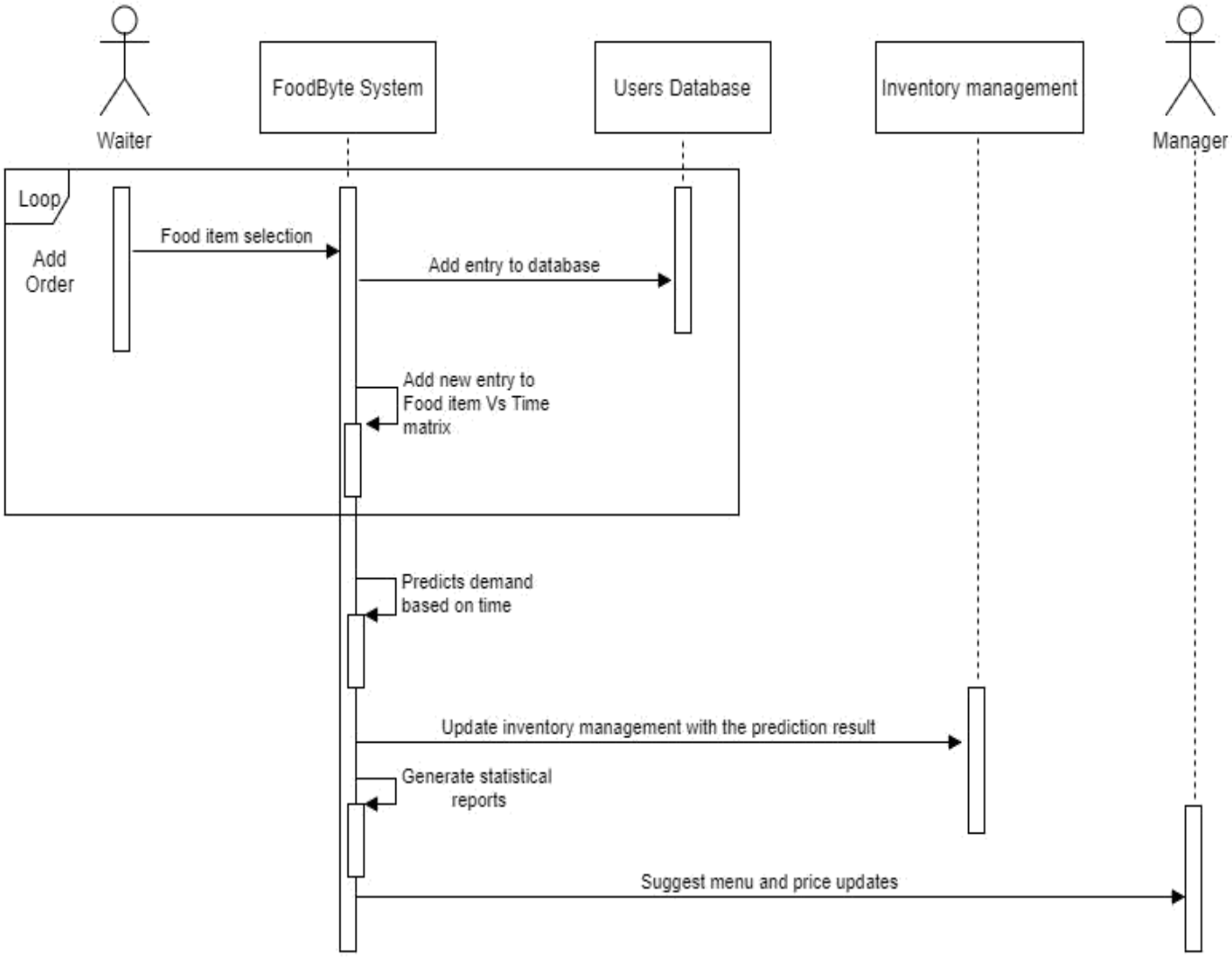

Waiter
FoodByte System
Users Database
Inventory management
Manager
Loop
Add
Order
Food item selection
Add entry to database
Add new entry to
Food item Vs Time
matrix
Predicts demand
based on time
Update inventory management with the prediction result
Generate statistical
reports
Suggest menu and price updates

Table 8

USE CASE UC3	**Analysis based on Customer density**
Related Requirements	RQ5, RQ6, RQ7 from Table1
Initiating Actor	FoodByte system
Actor's Goal	To retrieve entries from the Users Database and suggest menu updates based on type of customers
Participating Actors	Users Database
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs Type of Customer dataset
Postconditions	The system should use the Food item vs Type of customer matrix to predict peak working hours and suggest menu updates at those times
Flow of Events for Main Success Scenario	⟶ 1. The system receives notification about new entries from portal ⟵ 2. System retrieves the required dataset from the Users database ⟵ 3. System predicts the peak working hours during the day based on the type of customers and suggest menu updates based on these predictions ⟵ 4. System will consolidate these predictions to display statistical reports

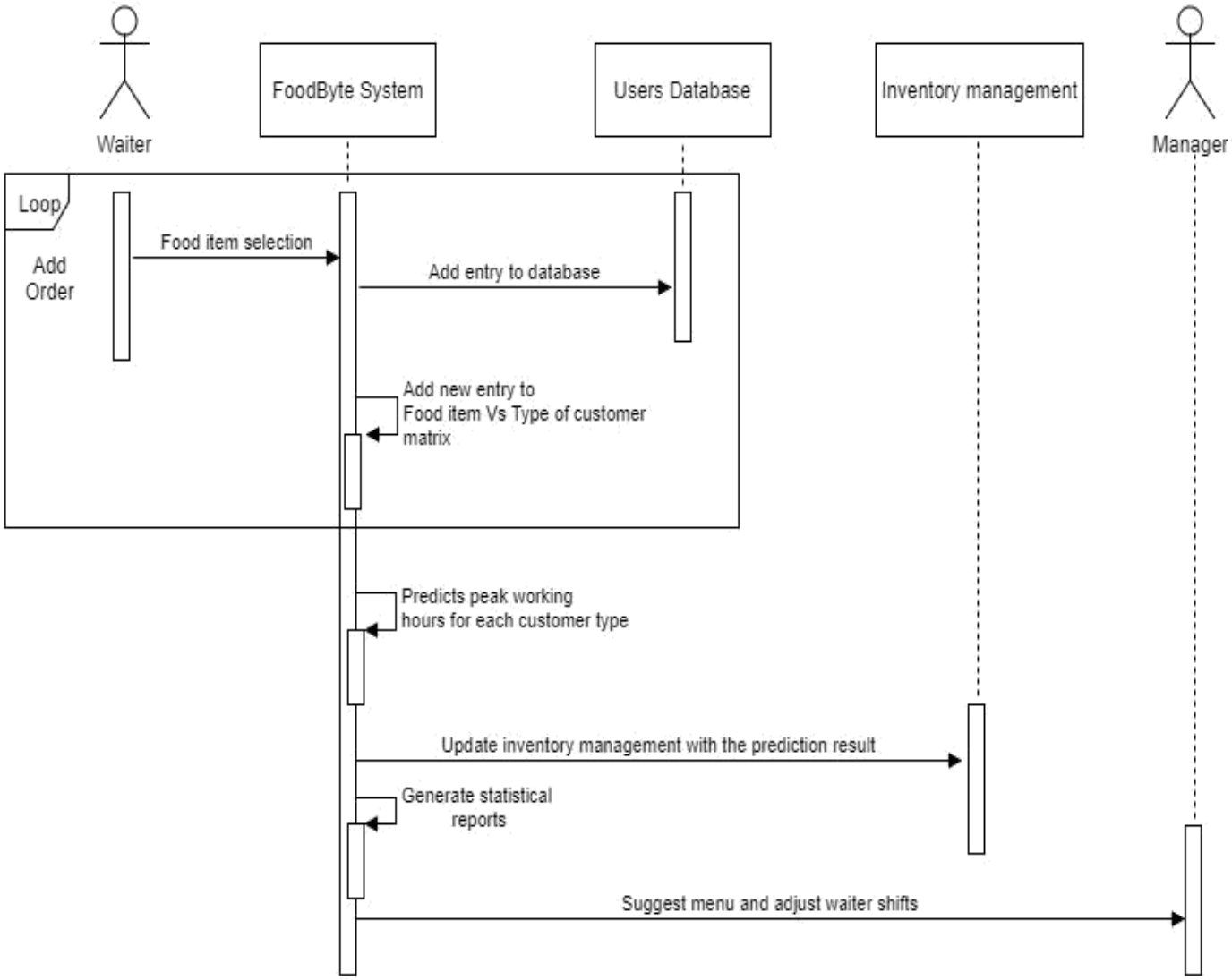

Waiter
FoodByte System
Users Database
Inventory management
Manager
Loop
Add
Order
Food item selection
Add entry to database
Add new entry to
Food item Vs Type of customer
matrix
Predicts peak working
hours for each customer type
Update inventory management with the prediction result
Generate statistical
reports
Suggest menu and adjust waiter shifts

Table 9

USE CASE UC4	**Trend Analysis based on Geography**
Related Requirements	RQ8, RQ9, RQ10 from Table1
Initiating Actor	FoodByte system
Actor's Goal	To retrieve entries from the Users Database and suggest price changes based on location
Participating Actors	Users Database, Inventory Database
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs Type of Location dataset
Postconditions	The system should use the Food item vs Location matrix and predict the price changes or special offers needed at specific locations of the restaurant
Flow of Events for Main Success Scenario	⟶ 1. The system receives notification about new entries from portal ⟵ 2. System retrieves the required dataset from the Users database ⟵ 3. System predicts the popularity index of food items at specific locations of the restaurant and use it to suggest price changes or special offers on specific food items ⟶ 4. System will notify the inventory management system about the changes in demand of food items at that location ⟵ 5. System will consolidate these predictions to display statistical reports

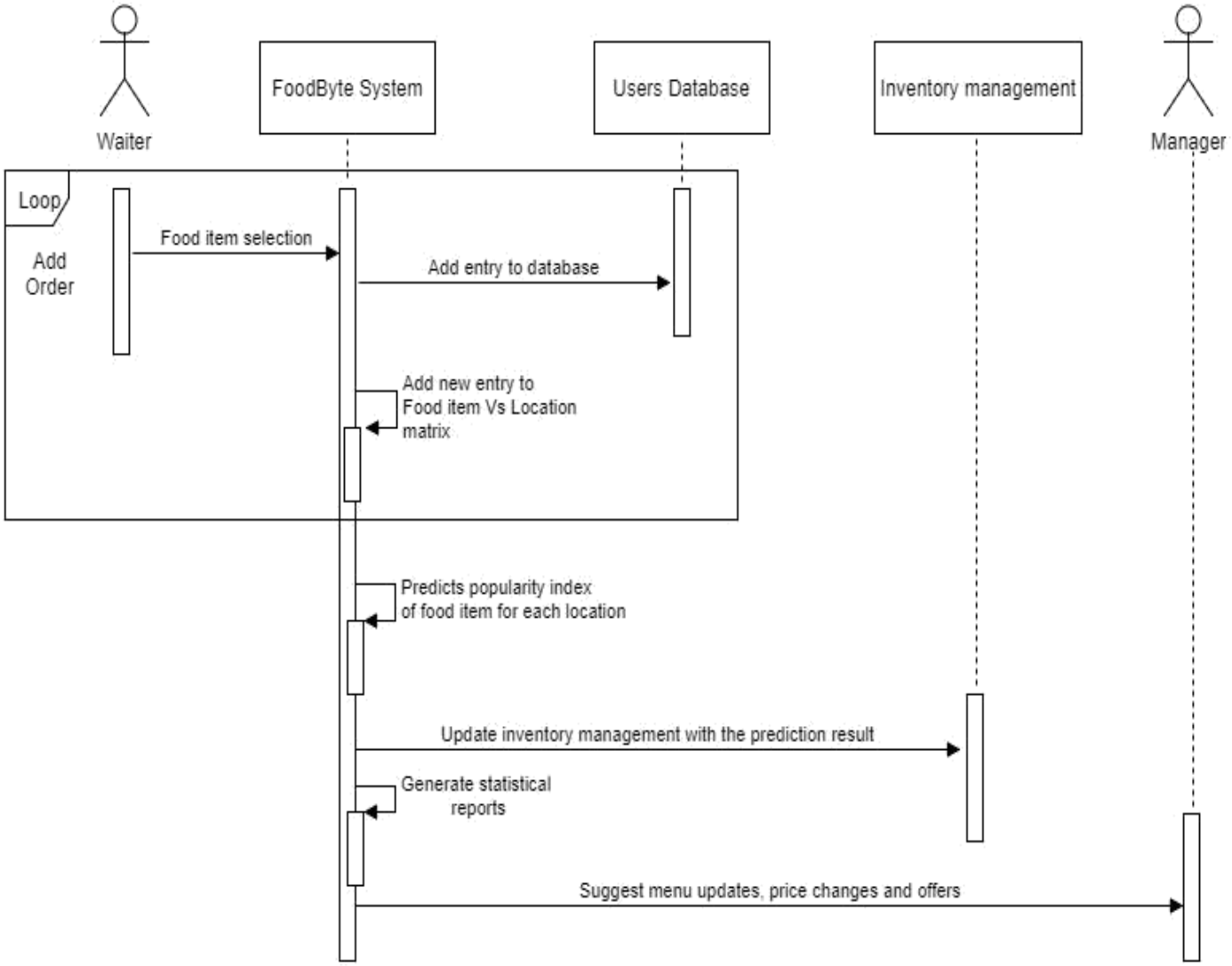

Waiter
FoodByte System
Users Database
Inventory management
Manager
Loop
Add
Order
Food item selection
Add entry to database
Add new entry to
Food item Vs Location
matrix
Predicts popularity index
of food item for each location
Update inventory management with the prediction result
Generate statistical
reports
Suggest menu updates, price changes and offers

Table 10

USE CASE UC5	**Inventory Management**
Related Requirements	RQ11, RQ12, RQ13 from Table1
Initiating Actor	FoodByte system
Actor's Goal	To retrieve entries from the Inventory Database and predict the required raw materials based on demand
Participating Actors	Users Database, Inventory Database
Preconditions	- Inventory Database should updated with latest entries - The system should have the Food item vs Inventory dataset
Postconditions	The system should use the Food item vs Inventory matrix, predict the rate of consumption of an ingredient and allow the restaurant to maintain the stock at peak times
Flow of Events for Main Success Scenario	→ 1. The system receives notification about new entries from portal ← 2. System retrieves the required dataset from the Inventory database ← 3. System predicts the rate of consumption of an ingredient and notify the restaurant management about the availability of popular ingredients. ← 4. System will consolidate these predictions to display statistical reports

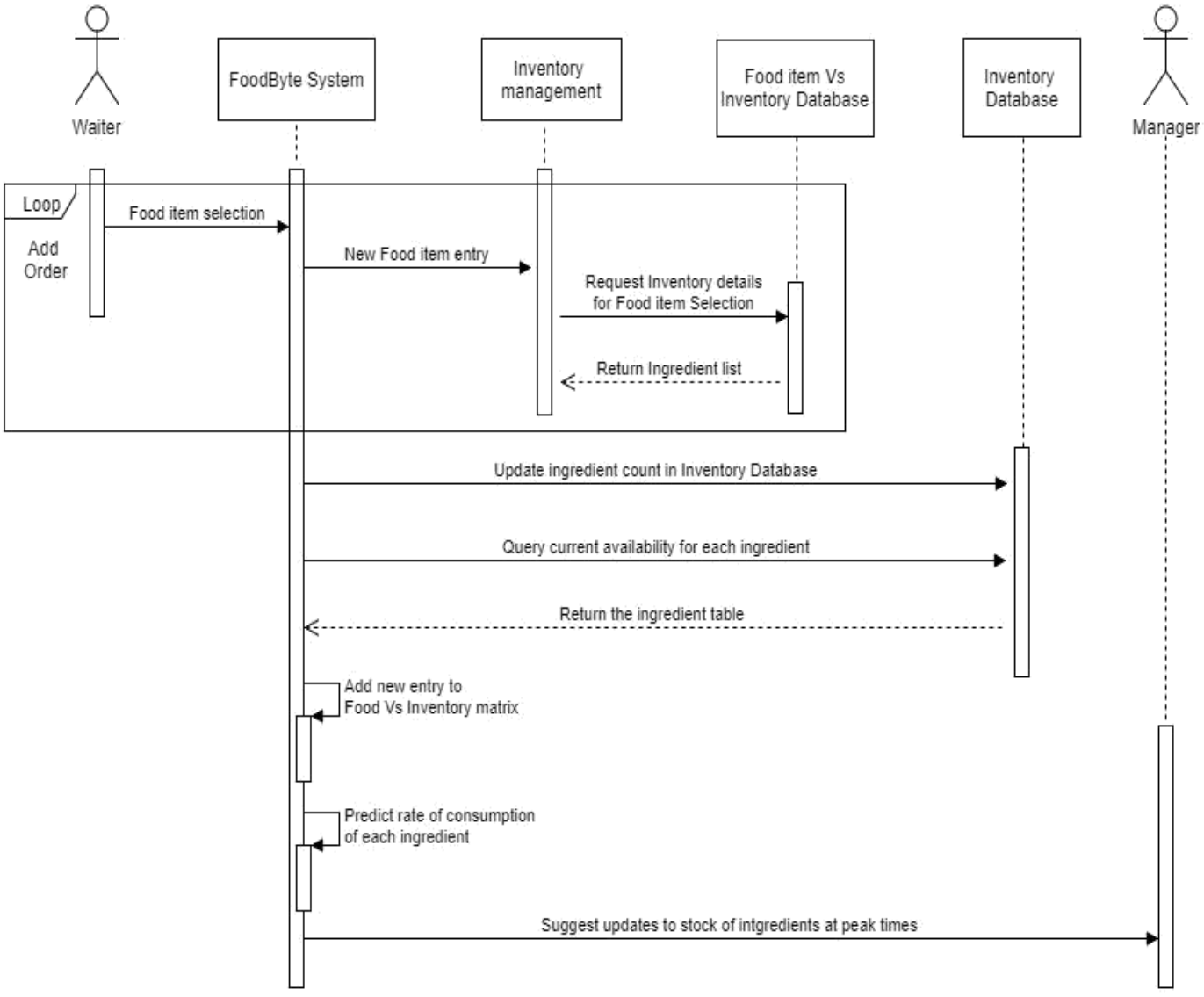
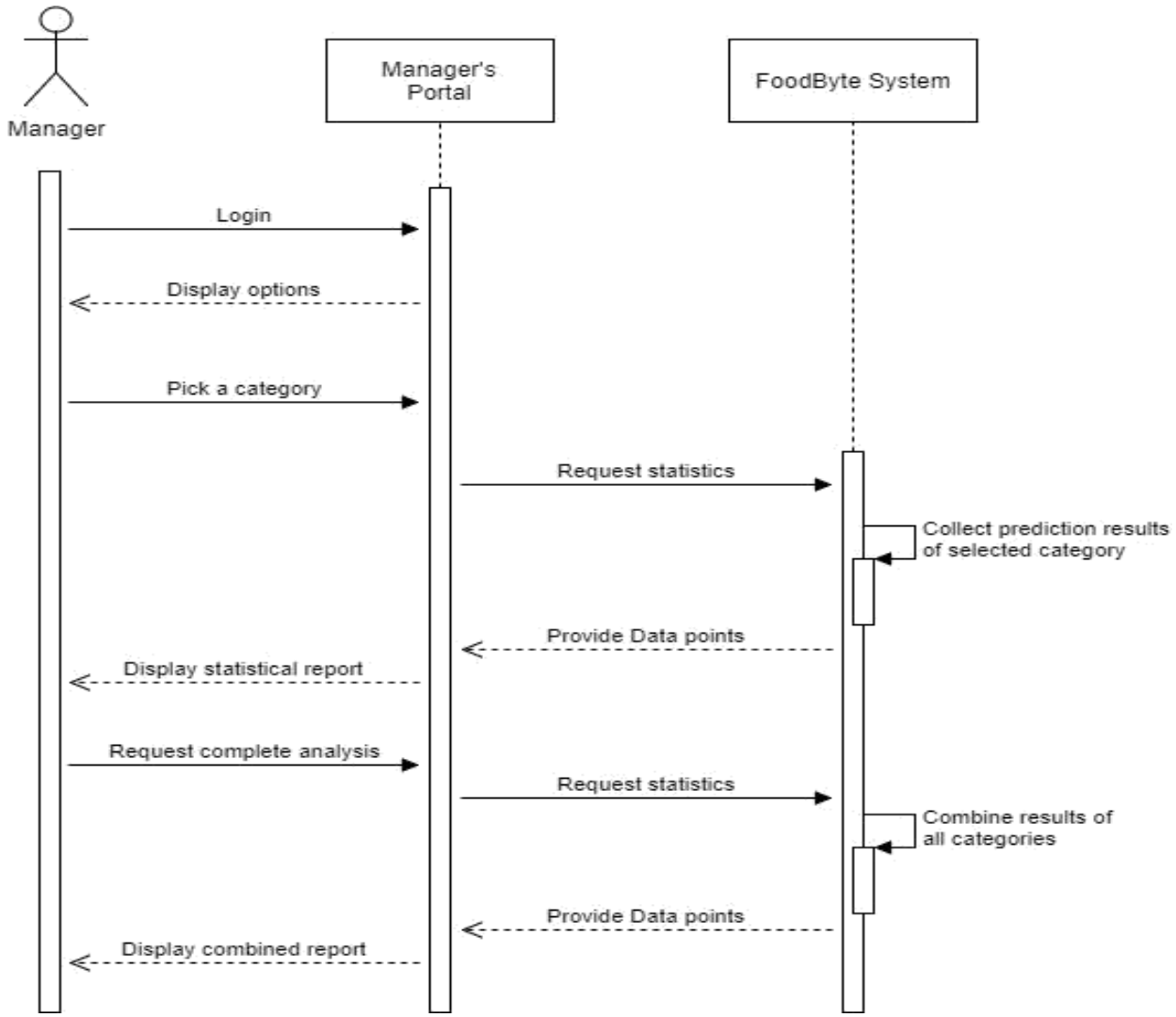

Waiter
FoodByte System
Inventory management
Food item Vs Inventory Database
Inventory Database
Manager
Loop
Add Order
Food item selection
New Food item entry
Request Inventory details for Food item Selection
Return Ingredient list
Update ingredient count in Inventory Database
Query current availability for each ingredient
Return the ingredient table
Add new entry to Food Vs Inventory matrix
Predict rate of consumption of each ingredient
Suggest updates to stock of intgredients at peak times

Table 11

USE CASE UC6	**Maintaining Statistics**
Related Requirements	RQ4, RQ7, RQ10, RQ13 from Table1
Initiating Actor	FoodByte system
Actor's Goal	To create the statistical report based on the predictions of UC2 – UC5
Participating Actors	Manager
Preconditions	- UC2 – UC5 should have completed their predictions - The system should be able to generate a UI based report
Postconditions	The system should integrate the individual predictions of UC2 – UC5 into a single conclusion
Flow of Events for Main Success Scenario	⟶ 1. The Manager logs into the FoodByte portal and requests a business report ⟵ 2. System integrates the predictions of all the modules into a conclusion. ⟵ 3. System displays a business report to the manager and provides multiple suggestions based on the statistics


Manager
Manager's Portal
FoodByte System
Login
Display options
Pick a category
Request statistics
Collect prediction results of selected category
Provide Data points
Display statistical report
Request complete analysis
Request statistics
Combine results of all categories
Provide Data points
Display combined report

8.USER INTERFACE SPECIFICATION:

8.1. Preliminary Design:

In this section the basic design of our project modules have been displayed as screenshots from our workplace.

Image 1: Displaying the menu

The food menu offered, and their prices will be displayed. Adding a menu or deleting a menu can be enabled by the manager.

Showing rows 0 - 17 (18 total, Query took 0.0043 seconds.)

```
SELECT * FROM `menu`
```

Show all | Number of rows: 25 Filter rows: Search this table

+ Options

Food	Price
Bacon Mac & Cheese	9.69
BBQ Chicken Mac & Cheese	9.69
Cuban Panini	9.99
Chipotle Chicken Avocado Melt	9.59
Roasted Turkey, Apple & Cheddar Sandwich	9.99
Baja Mac & Cheese	9.69
Ancient Grain, Arugula & Chicken Salad	10.19
Vegetarian Autumn Squash Soup	5.99
Turkey Chili	6.79
Chicken Tortellini Alfredo	9.19
Tortellini Alfredo Pasta	8.49
Blood Orange Lemonade	2.59
Superfruit Smoothie	4.99
Prickly Pear Hibiscus Fresca	2.59
Pumpkin Cookie	2.69
Greek Yogurt with Mixed Berries Parfait	4.29
Cherry Vanilla Bagel	1.39
Regular coffee	4.39

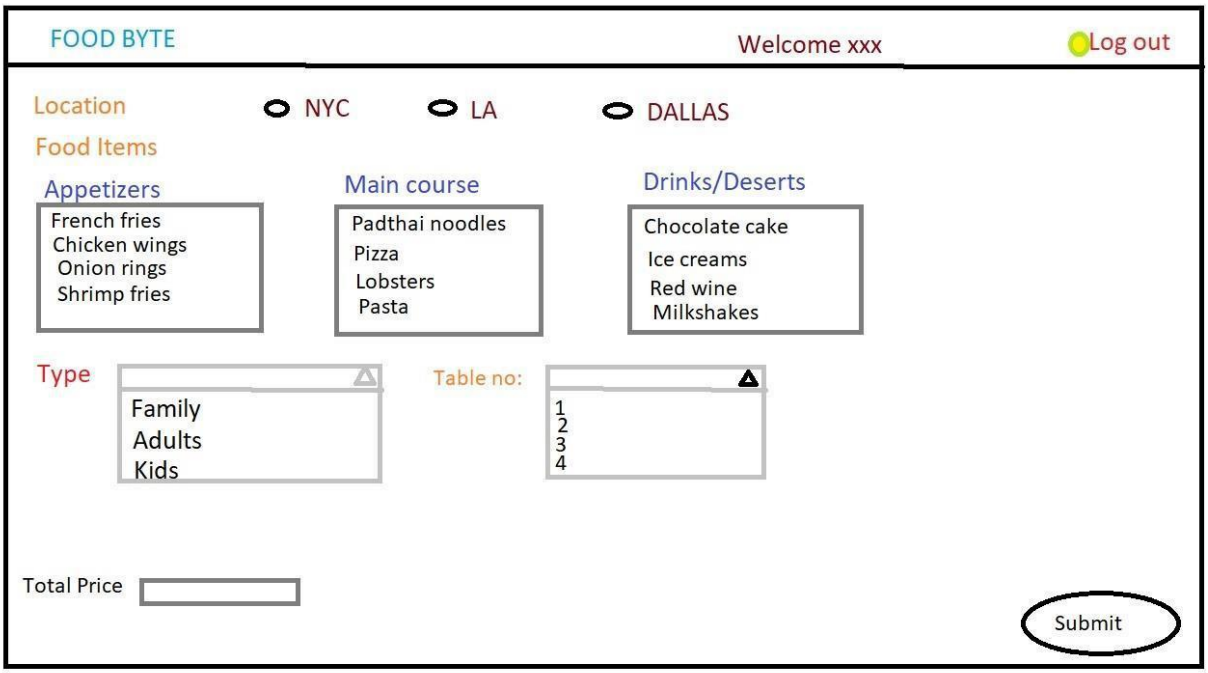
Show all | Number of rows: 25 Filter rows: Search this table

Image 2: Menu selection.

The waiter will have a page to input the food ordered by the customer from the menu displayed. Multiple selections can also be done.

The manager will have a page to check the statistical reports generate from each of the data analytics algorithms

Waiter page



Manager page

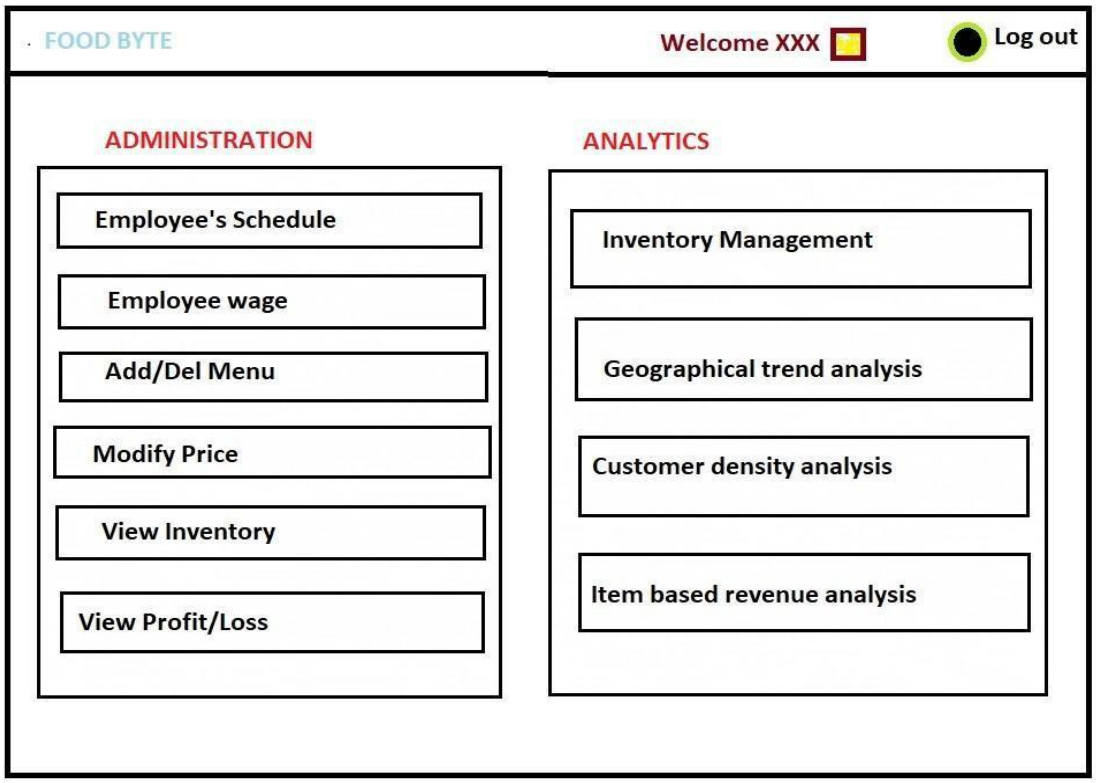


Image 3: Ingredient Lookup

The total number of food and the ingredients used for each food item is stored on a separate database.

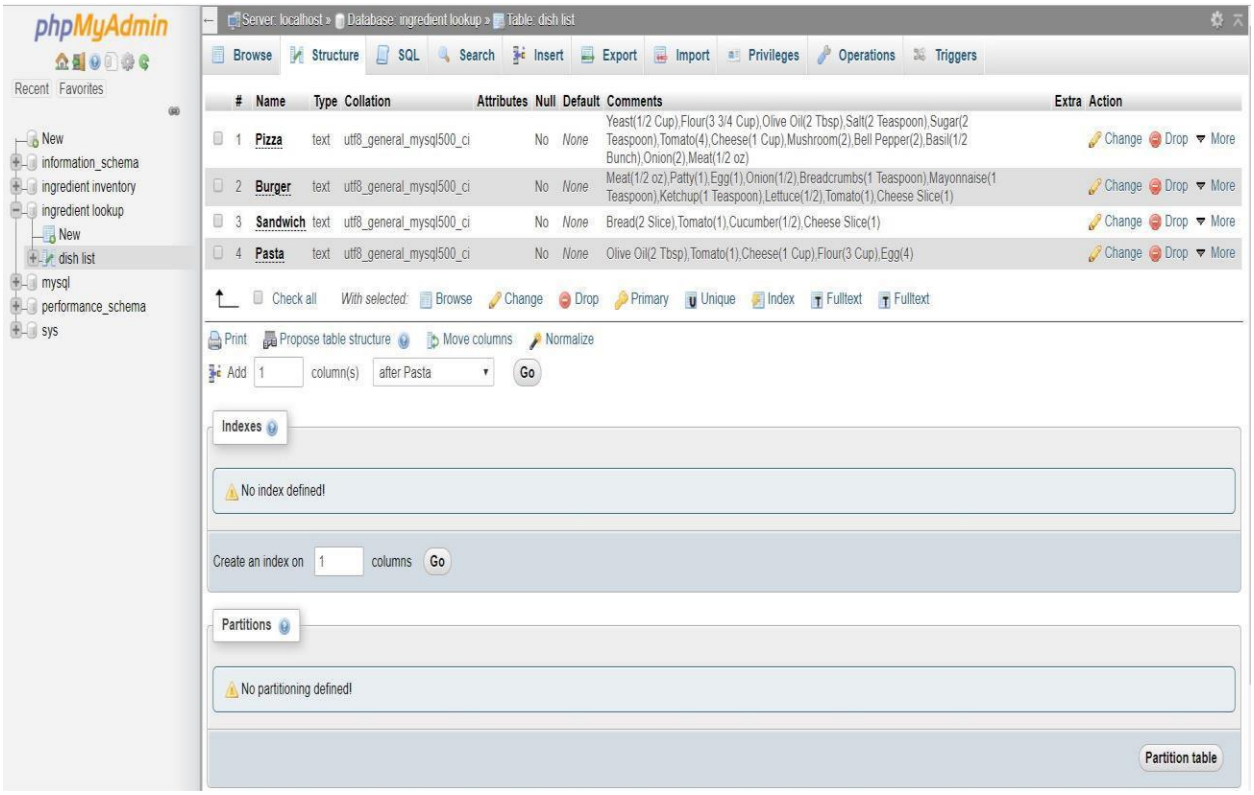
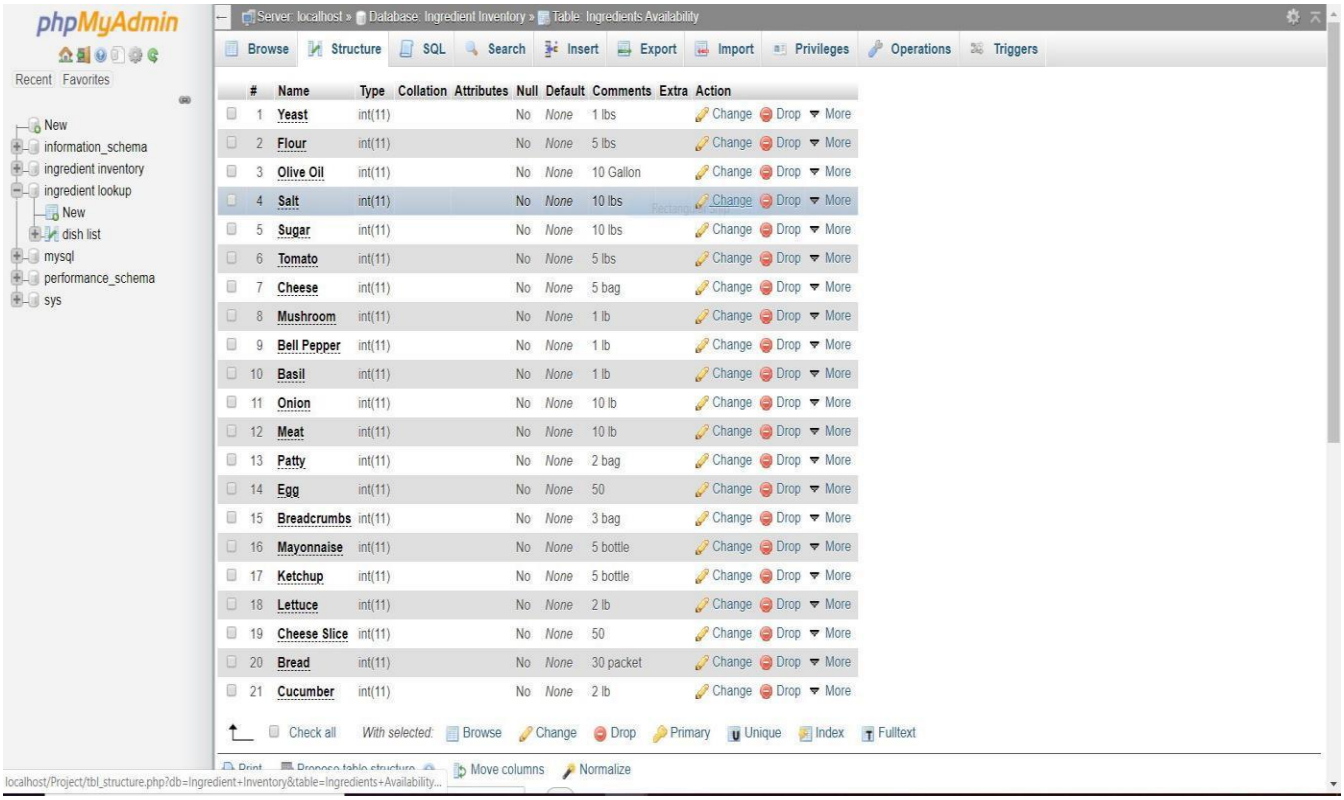


Image 4: Ingredient availability

After each item is ordered and prepared the used ingredients will be decremented from the inventory availability database. All this information will be needed for the data analytics.



8.2. Effort Estimation

Scenario 1: Waiter Places Order

a) Select the menu option.

b) Select the desired item.

c) Select the desired item, tap more than once to increase quantity

d) Once all desired items are in the order, select “place order” to add the order to the queue.

Scenario 2: Manager decides to view the trend analysis based on geography.

a) Select the option “trend analysis based on geography”

b) Select the item to remove it or modify its price based on the report.

c) Select the “total sales” option to view the sales

Scenario 3: Manager wants to build a quotation for required items for the following month.

a) Select the option “Inventory Available”

b) Select the option “Build quote for 1 month”

Scenario 4: Manager wants to build new menu based on inventory usage trend.

a) Select the option “Inventory”

b) Select the option “Insights”

c) Get the last month trend analysis of inventory list

d) Select “Suggest Menu”

Scenario 5: Manager wants to keep a track of the available Inventory.

a) Select the option “Inventory”

b) Select the option “Inventory Available” to view available resources

Scenario 6: Manager wants to keep a track of the popular items on the menu.

a) Select the option “sales database”.

b) Select the option “popularity”.

c) Enter the time to get time specific popularity in sales.

Scenario 7: Customer takes survey form

a) Enter basic details such as name, sex, age, vegetarian/non-vegetarian food preference
b) Select „Add member“
c) Repeat the same entries for all members of family/group visiting the restaurant
d) Provide feedback/comments in the „Customer Feedback“ box.
e) Click on „Submit“

Scenario 8: Manager wants to modify shifts and wages of employees

a) Select the tab „Analysis based on Customer Density“
b) Select the option „Employee Schedule“ to make changes to employee shifts
c) Select the option „Employee Salary“ to modify employee wages

Scenario 9: Manager wants to make business decisions based on customer density

a) Select the tab „Analysis based on Customer Density“
b) Select the option „Customer Survey Analysis“ to see peak/off-peak hours, type of customers and their food preferences
c) Make executive decisions to improve or change business practices based on suggestions provided by the system in the option „Recommendations and Tips“

9. DOMAIN ANALYSIS:

9.1. Domain Model:

a) Concept Definitions:

Table 12

Responsibility Description	Type	Concept
R-01: Displays profit/losses, analysis of food item based on location and suggests modification of the menu accordingly.	D	FoodPopularity
R-02: Displays analysis based on customer density and suggests number of employees to be assigned.	D	CustomerDensity
R-03: Knows all orders from all customers/tables	K	OrderQueue
R-04: Views the items left in inventory and manages the inventory accordingly.	D	Manger
R-05: Place food orders within the restaurant	K	Waiter
R-06: Place drink orders within the restaurant	K	Waiter
R-07: System knows count of ingredients	K	Ingredientcount
R-08: Can view the statistics of the items sold and remove the least sold item	D	Manager
R-09: System displays the statistics about the ingredients in the inventory	K	Ingredientcount
R-10: System knows schedule of all employees	K	Schedule
R-11: Can edit expenses of store	D	Manager
R-12: System sends orders to the restaurant.	D	Order
R-13: Modify menu	D	MenuModifier
R-14: System knows schedule of all employees	K	Schedule

R-15: Can modify the item‟s price	D	Manager
R-16: Can provide discounts/offers on a particular item	D	Manger
R-17: Can provide info about place	K	Location
R-18: Can store info and update it	K	DatabaseConnectiom

b) Association Definitions:

Table 13

Concept Pair	**Association Description**	**Associate Name**
Manager ↔ MenuModifer	Allows manager to modify menu	Modifies
Manager ↔ IngredientCount	Manager requests updates on IngredientCount to manage menu items	Requests Updates
Customer ↔ Waiter	Customer passes order requests to waiter	Conveys Requests
Manager ↔ Schedule	Schedule passes employee‟s schedule requests to manager	Conveys Requests
Manager ↔CustomerDensity	Allows manager to view customer density statistics	Provides Data
Manager ↔FoodPopularity	Allows manager to view popular/least selling items	Provides Data
Waiter ↔Order	Allows the waiter to take order from customer	Provides Data
Waiter↔Location	Allows waiter to select location of restaurant	Provides data
Manager↔DatabaseConnection	Allows manager to view and update information correctly	Provides Data

c) Attribute Definitions:

Table 14

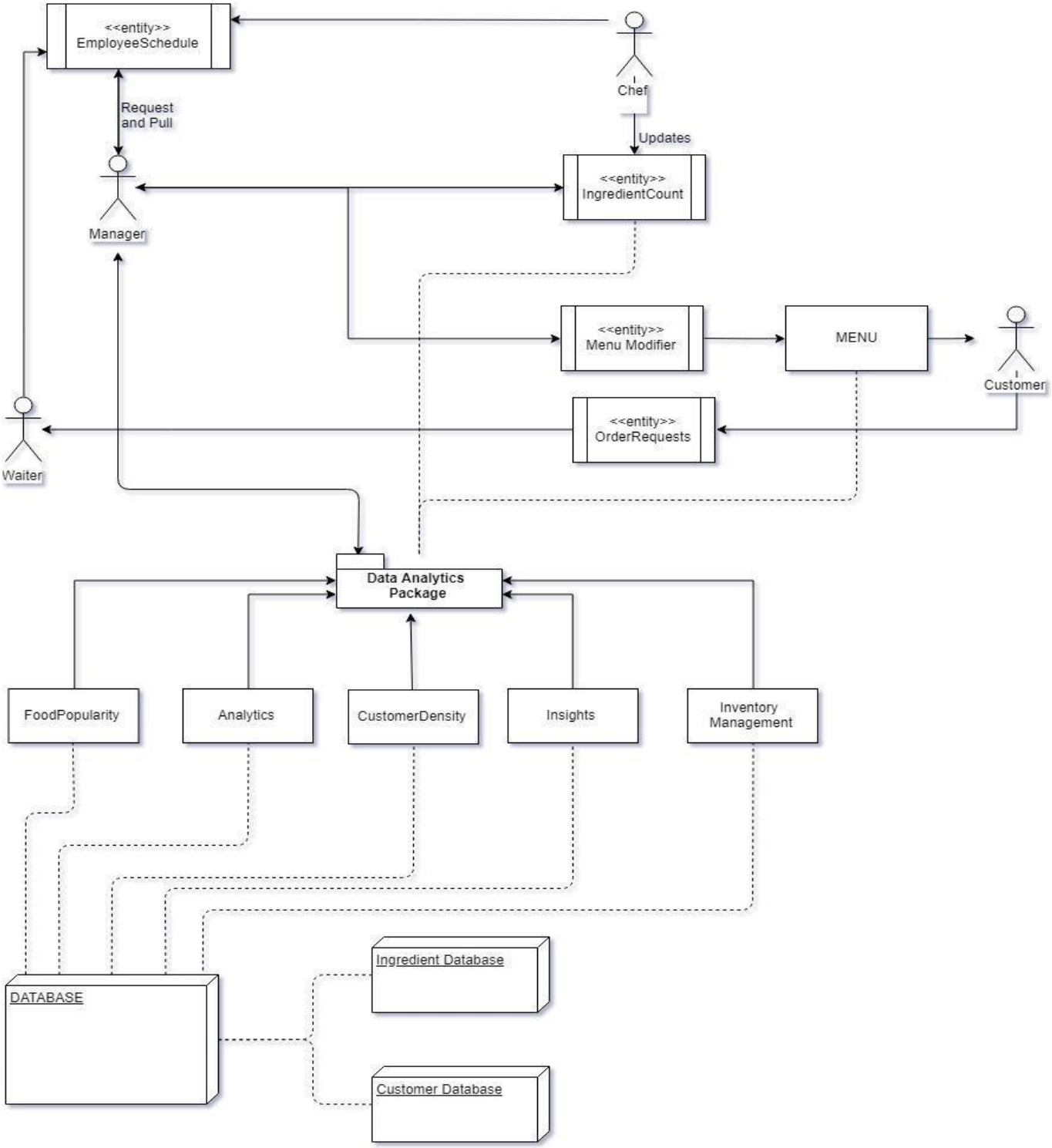
Concept	Attribute	Attribute Description
Manager	Name	Name of Manager
	Manager ID	Manager has a unique identification credential associated with login
	Privileges	Manager has specific privileges including menu modifications, modify number of waiters working at a particular time, view different statistics related to sales, inventory etc, profit/loss, etc.
Waiter	Name	Name of the waiter
	Waiter ID	Each waiter has a unique identification credential associated with them
FoodPopularity	Favourite	The most sold item of the restaurant
	Least popular	The least sold item
OrderQueue	Orders	Orders are placed on a queue within the system.
Order	Customer Information	Information about the customer who placed the order.
	Location	The current location of the restaurant
	Food item	The item ordered by the customer
Schedule	Date	The various dates available on the schedule
	Time	The time slots available on each day
	Employee Name	Name of the employee working a certain shift
IngredientCount	Name	Name of the ingredient

	Total Stock	Amount of stock available in the kitchen for each ingredient
MenuModifier	Name of Item	Allows for altering the name of the selected item
	Ingredients	Allows for altering ingredients of a selected item
	Price	Allows for altering the price of a selected item
CustomerDensity	Number of customers	Tracking the number of customers at particular time during the day
	Number of employees	Used to determine the number of employees required for a particular shift based on the customer density
	Time	The time slots available on each day
DatabaseConnection	Status	Shows if connected or not in order to udate information correctly
Location	Name	Provides crucial information about the location for data analytics

9.2 Traceability Matrix

	Domain Concepts										
Use Case	FoodPopularity	CustomerDensity	OrderQueue	Manager	Waiter	IngredientCount	Schedule	Order	Location	DatabaseConnection	MenuModifier
UC1			X		X			X			
UC2	X			X	X		X				X
UC3		X		X	X		X				X
UC4				X					X		X
UC5	X	X		X		X					
UC6				X						X	

9.3 Domain Model Diagram



10. SYSTEM OPERATIONS CONTRACT

Table 15

Name	To place an order
Responsibilities	To take the order from the customer and select it in the FoodByte portal.
Use Cases	UC-1
Exceptions	None
Preconditions	- Menu Database should contain the updated values. - The FoodByte portal should be synced with the Menu Database.
Postconditions	The User Database should be updated with the Customer selection and notification

Table 16

Name	Trend Analysis in sales based on time
Responsibilities	To retrieve entries from the Users Database and provide sales predictions at specific times
Use Cases	UC-2
Exceptions	None
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs time dataset in the required form
Postconditions	The system should use the Food item vs Time matrix from the dataset and provide predictions about the demand at specific times during the day

Table 17

Name	Analysis based on Customer density
Responsibilities	To retrieve entries from the Users Database and suggest menu updates based on type of customers
Use Cases	UC-3
Exceptions	None
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs Type of customer dataset
Postconditions	The system should use the Food item vs Type of customer matrix to predict peak working hours and suggest menu updates at those times

Table 18

Name	Trend Analysis based on Geography
Responsibilities	To retrieve entries from the Users Database and suggest price changes based on location
Use Cases	UC-4
Exceptions	None
Preconditions	- Users Database should updated with latest entries - The system should have the Food item vs Type of Location dataset
Postconditions	The system should use the Food item vs Location matrix and predict the price changes or special offers needed at specific locations of the restaurant

Table 19

Name	Inventory Management
Responsibilities	To retrieve entries from the Inventory Database and predict the required raw materials based on demand
Use Cases	UC-5
Exceptions	None
Preconditions	- Inventory Database should updated with latest entries - The system should have the Food item vs Inventory dataset

Postconditions	The system should use the Food item vs Inventory matrix, predict the rate of consumption of an ingredient and allow the restaurant to maintain the stock at peak times

Table 20

Name	Maintaining Statistics
Responsibilities	To create the statistical report based on the predictions of UC2 – UC5
Use Cases	UC-6
Exceptions	None
Preconditions	- UC2 – UC5 should have completed their predictions - The system should be able to generate a UI based report
Postconditions	The system should integrate the individual predictions of UC2 – UC5 into a single conclusion

11. Mathematical Models

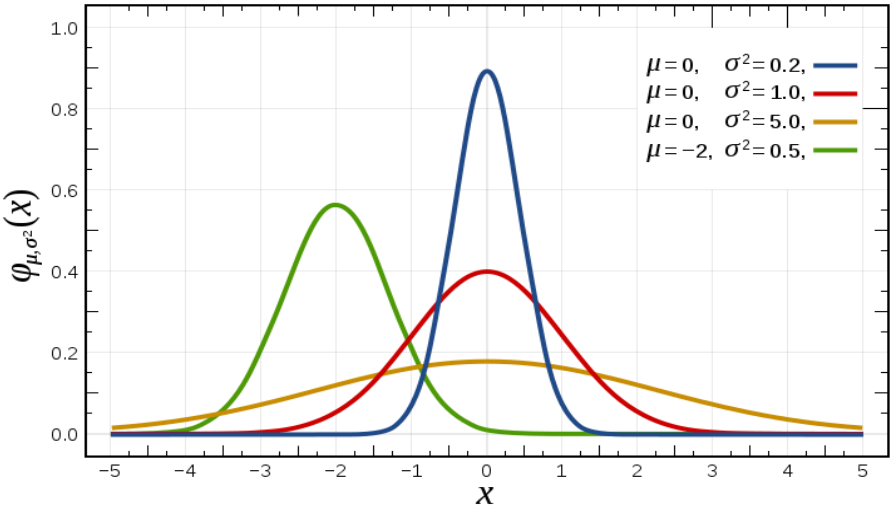
1)Creating artificial datasets:

Let N be the number of entries in the dataset. We will divide this number into P subsets. Each subset will have N/P entries. Each entry will contain values of Food type, Customer Density, Price, Location, Time of the day and ethnicity. We will use **Gaussian distribution** between the P subsets to calculate the probability of the value for each field within that subset.

$$f(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

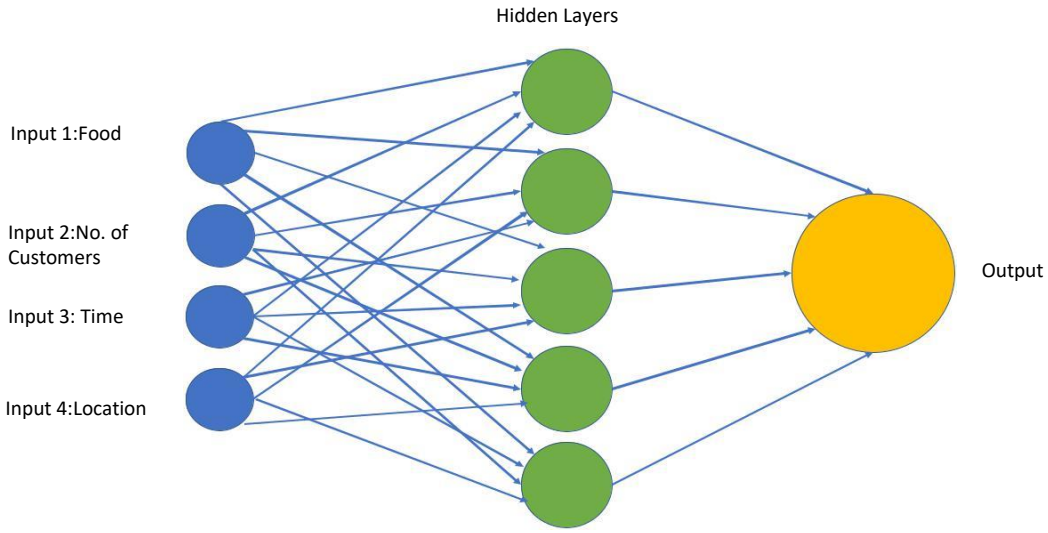
where

- μ is the mean or expectation of the distribution (and also its median and mode),
- σ is the standard deviation, and
- σ^2 is the variance.



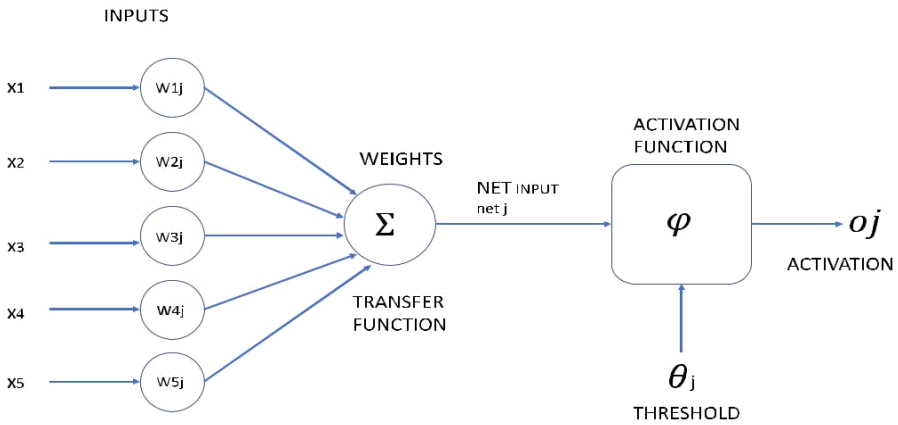
For example, x% of people in southern part of the US prefer Mexican food (Initial data from Statistical report). This value will be considered as mean and will be part of the 1st subset. The rest P-1 subsets will have values ranging from (x-sigma)% to (x+sigma)%. This method will be used for all the food categories, locations and time values. This will create a dataset which will be pseudo random, i.e initial data based on observations and variation based on mathematical modelling.

2)Our project uses the collection of datasets as the input and uses machine learning tasks to perform computations that yield meaningful results relevant to the outlined objectives of the project. We will use the supervised learning approach to perform analysis on the data. Specifically, classifiers will be used to observe the input data and then classify into new observations. We have chosen the structural classifier neural networks computing system to manipulate our data.



Basic Model of Neural Networks

As the figure above shows, we our collected data as inputs and pass them through a hidden layer to perform some manipulations through which we obtain an output that can be interpreted.

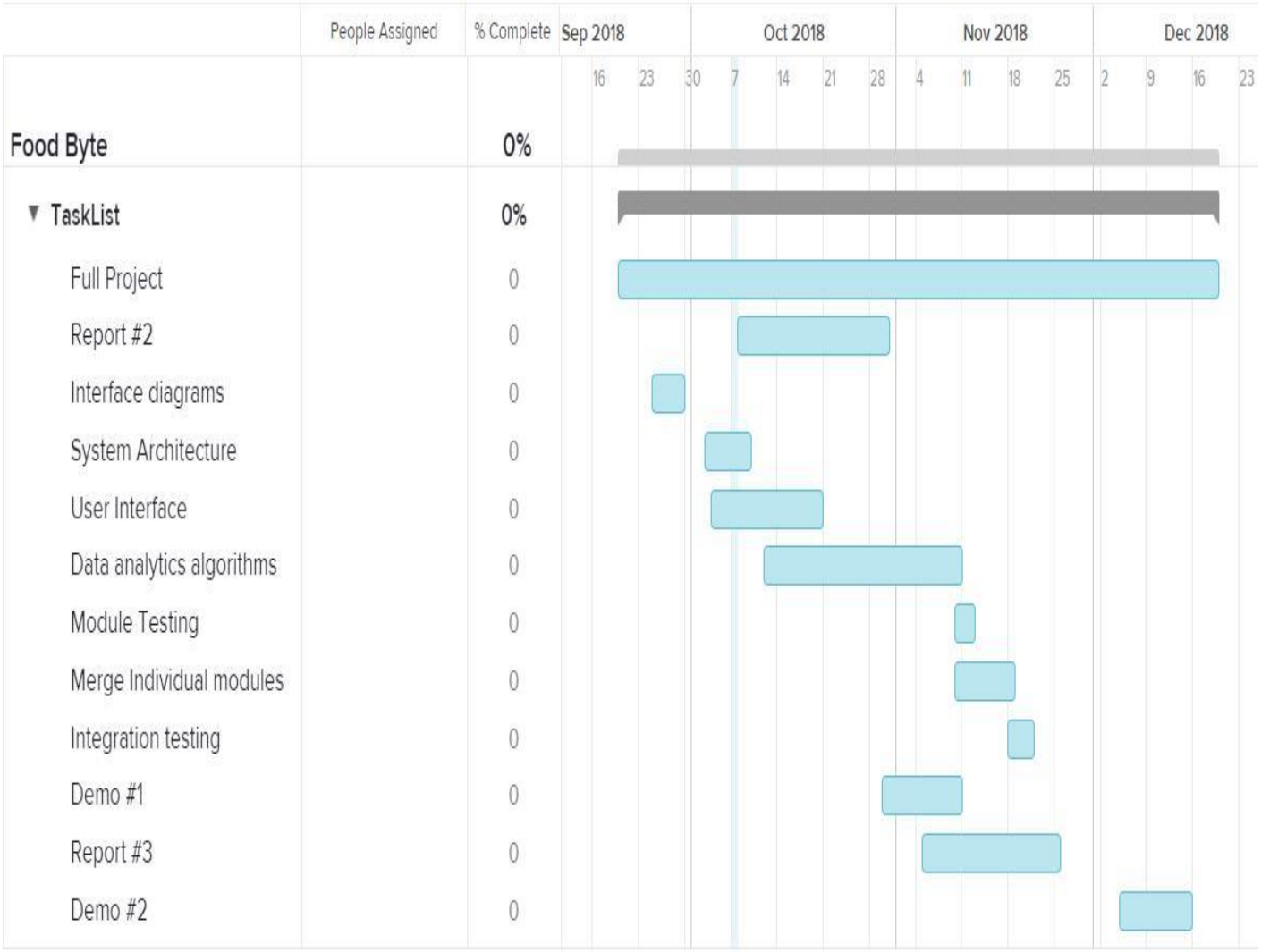


NEURAL NETWORK FRAMEWORK

In the diagram above, we choose the 6 inputs to be the type of food, its price, the location of the restaurant, the number of customers and the time that the order was placed. The inputs are then multiplied with weights and combined to form the net input which is then sent to the activation function, which adds non-linear properties to the data. Depending on the accuracy and relevance of the output rendered, the kind of activation function will be chosen from the Python libraries.

12. PLAN OF WORK

12.1 Gantt chart



12.2 Product Ownership

We have divided our group of 8 team members into 4 teams with 2 members each. Each team will work on an independent data analytics module which will be tested independently. We will then integrate all the modules before integration testing. The teams are as follows: Yashasvi and Akshay, Prince and Sarthak, Anvitha and Priyanka, Suraj and Ashwin. The objective for the next few weeks would be to get the UI design completed for all role players and start working on data analytics for each module.

- ## Yashasvi and Akshay

Completed tasks: Created a first draft of the UI for the waiter with login. Also created a menu database and Users database.

Current tasks: To create the required dataset using menu selections from the portal

Future tasks: To start using this dataset for creating the Fooditem vs Location matrix which will be needed for calculating the popularity index of each item for each location.

- ## Suraj and Ashwin

Completed tasks: Database analysis for the required fields and entries needed for Item based revenue maximization

Current tasks: Working on libraries and functions in Python that can be used for implementation

Future tasks: Start working on already created dataset and use data from specific columns in the Users Database for revenue prediction.

- ## Anvitha and Priyanka

Completed tasks: Created a first draft UI of the Manager‟s account

Current tasks: Exploring data analytics algorithms to determine how many employees are required each shift based on the number of customers

Future tasks: Implement more features, which include:

- Analyzing the type of customers and their food preferences
- Formulate business solutions based on results of analysis

- # Prince and Sarthak

Completed tasks: Created a first draft of the UI for chef and created the Inventory database for food item vs ingredient mapping

Current tasks: Link the Ingredient lookup tables and Ingredient availability to the server-side program which will create the required dataset.

Future tasks: Using the generated dataset, we will add following functionalities

- Ingredient Consumption: To understand the rate of usage of specific ingredients, maximize profitability, and reduce wastage.
- Suggest Changes to the Menu: To increase profitability by making dishes that will help replenish the least used ingredients and avoid wastage.

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